Australian Bureau of Statistics

1350.0 - Australian Economic Indicators, 1993

ARCHIVED ISSUE Released at 11:30 AM (CANBERRA TIME) 13/04/1993

1993 Feature Article - An Experimental Composite Leading Indicator of the Australian Business Cycle

This article was published in Australian Economic Indicators May 1993 issue on 3 May 1993.

Introduction

To assist and encourage informed decision making by governments, businesses and the community, the ABS is investigating means of providing earlier signals of movements in economic activity. In particular, it is:

- developing collections of additional data on businesses' expectations of future economic conditions;
- investigating the feasibility of collecting data on householders' expectations;
- refining the analysis and interpretation of the expectations data it already collects; and
- developing a composite leading indicator of the business cycle which is intended to summarise the early signals contained in individual partial economic indicators.

This article is the third in a series dealing with the Australian business cycle and its leading indicators. The first article described the Australian business cycle (Salou and Kim, August 1992). The second studied the temporal relationships at turning points between the Australian business cycle and a selection of main economic indicators (Salou and Kim, October 1992). The conclusion of the latter was that individual economic indicators are unreliable for forecasting business cycle turning points, the main reasons being the many different causes and facets of business cycles. This article shows how the combination of individual indicators to form a composite leading indicator (CLI) improves the reliability of the forecasting of turning points. The construction of the indicator and its properties are also described. Static, as well as dynamic, evaluations are performed with particular attention paid to the effects of filtering and data revisions. The last section of the paper explains how to interpret the CLI in forecasting mode.

The CLI has been developed to supplement, rather than compete with, existing forms of economic analysis and modelling and indicators produced by other organisations. It should be noted that the primary use of the CLI is the detection of turning points in the business cycle, not the forecasting of the level of any measure of economic activity. The analysis underlying the development of the CLI has focused on business cycles, which are obtained by removing the long-term trend from the overall measure of economic activity, constant price GDP(A). The expansionary and contractionary phases identified by movements in the CLI are periods of acceleration and slowdown respectively in economic activity relative to the long term trend of constant price GDP(A). As a result, a negative value of the CLI does not necessarily indicate that GDP(A) growth will be negative. It could simply mean that, even though growth in GDP(A) is positive, it will be below the growth of its long-term trend. The main function of the CLI is in

predicting when turning points relative to the long-term trend of GDP(A) are reached.

The ABS is continuing with the experimental development of the CLI, testing its performance as new data become available, with the intention of publishing an information paper on the CLI in the near future and thereafter publishing the CLI quarterly.

Rationale for aggregating individual indicators

In the October 1992 issue of Australian Economic Indicators, the performance of economic indicators over the past two decades was examined (Salou and Kim, op. cit.). The main conclusion of this analysis was that, while individual economic indicators contain some information about short-term movements in aggregate economic activity, they may also show extra or missing cycles and produce false signals. Consequently, using indicators independently to forecast turning points in the business cycle is unreliable. This reflects the fact that all cycles are different in their causes, effects, duration and amplitude. Aggregating individual leading indicators into a composite indicator broadens the coverage of the possible causes and early indications of future or current fluctuations in the economy.

Aggregation therefore improves the forecasting ability of the system of leading indicators. The resulting indicator can be seen as a summary of the early signals contained in each individual component. A composite indicator is therefore more likely to capture future fluctuations than each component used independently. For the same reason, the composite indicator will produce fewer false signals than any individual indicator used in isolation. The aggregation process also reduces any measurement errors that may be present in the individual indicators for the most recent observations. More details on the aggregation technique and its history can be found in Zarnowitz (1992). Other composite leading indicators for the Australian economy have been developed and published (see for instance Boehm and Moore,1984).

Selection of components

Individual indicators were selected for inclusion in the CLI according to their economic significance and coverage, their cyclical conformity and their timeliness. The main results of their evaluation against these criteria have been reported in Salou and Kim (October 1992, op. cit.). The experimental CLI is an aggregation of the following eight time series:

- **Real interest rates, lagged four quarters:** An estimate of real short-term interest rates was computed by subtracting the annual growth in the final domestic demand fixed-weighted price index (growth rate from the corresponding quarter the year before) from the quarterly average of the two year Treasury bond rate.

- **Commodity price/Producer Price Index (PPI), imported materials:** The commodity price index used was that compiled by the Australian Bureau of Agricultural and Resource Economics. It includes the more relevant world market prices for Australian export commodities weighted by their share of exports in 1987-88. It is expressed in Special Drawing Rights in order to exclude exchange rate movements. The producer price index of imported materials is compiled by the ABS (cat. no. 6411.0). The ratio gives an early estimation of terms of trade.

- **USA GDP:** The United States gross domestic product from the United States Bureau of Economic Analysis, Department of Commerce.

- **Job vacancies, all industries:** The ABS quarterly data on job vacancies, all industries (ABS cat. no. 6354.0), are available in continuous series from 1980.

- **Housing finance commitments:** The value of total secured housing finance commitments

to individuals (ABS cat. no. 5609.0), deflated by the housing component of the consumer price index.

- **All Industrials index:** Index of the market prices of a sample of shares of 240 Australian companies on the Sydney and Melbourne Stock exchanges. It excludes mining, oil and other resources shares.
- **Production expectations, lagged one quarter:** Compiled by the Australian Chamber of Commerce and Industry and Westpac. This series has been smoothed but not detrended, since investigations indicated that entrepreneurs' expectations do not contain any long-term trend.
- **Business expectations, lagged one quarter:** Compiled by the Australian Chamber of Commerce and Industry and Westpac. This series has been smoothed but not detrended, since investigations indicated that entrepreneurs' expectations do not contain any long-term trend.

The performance of these components when used independently is summarised in Table 1. The particular combination used to construct the CLI was chosen after several iterations of the performance evaluation described below, using tests for cyclical conformity, timeliness and behaviour in dynamic mode. The coverage of the CLI was also a criterion in the selection of components. The proposed CLI has a balanced coverage of several different aspects of economic activity. External demand (US GDP), monetary policy (real interest rates), a measure of terms of trade (ratio of commodity prices to import prices), pressures on production capacity (job vacancies), internal demand (housing finance) and entrepreneurs' expectations (production and business expectations) are represented. The first three of the eight components of the CLI are measures of forces driving the Australian economy. Job vacancies and housing finance are early indicators of changes in production and demand conditions. The All industrials index and the two expectations indicators incorporate assessments of the future by players in the economy.

TABLE 1. LEADS AND LAGS OF INDIVIDUAL COMPONENTS
(position relative to business cycle in quarters)

Turning point in	**72 Q2**	**73 Q4**	**75 Q3**	**76Q3**	**77Q4**	**78Q4**	**80Q2**	**82 Q1**	**83 Q1**	**85 Q3**	**86 Q4**	**89Q4**	**91 Q3**
Trough/Peak	T	P	T	P	T	P	T	P	T	P	T	P	T
Real interest rate (inverse)	7	6	5	6	2			9	6	11	7	6	9
Commodity price/PPI Imported materials	2	0	1	1	1	-1			3	3	1	5	0
USA GDP	2	2	2	2	0	0	-1	3	1	5	-1	-2	1
Job vacancies	na	na	na	na	na	na	na	1	-1	1	-4	2	1
Housing finance commitments	na	na	na	na	-1			6	2	1	2	5	3
All industrials index	3	3	3	2	3	1	3	3	1	7	4	0	3
Production expectations	2	3	3					4	1	0	1	5	3
Business expectations	3	5	4					4	2	7	2	5	2

It should be noted that not all of the series are available for the period considered, which is the March quarter 1971 to the September quarter 1992. The time series for housing finance starts in the September quarter 1975 and consistent data on job vacancies start in the March quarter 1980. All other time series are available from the beginning of the period.

Aggregation technique

The technique for aggregating the individual series can be summarised as follows:

- All series were first filtered to extract the business cycles by eliminating the long-term trend, and the seasonal, trading day and irregular variations.
- All series were standardised so that their amplitudes had an average of one and a deviation from average of one. This was done to reduce the weight of the more volatile series.
- The standardised components were aggregated with equal weights. During the aggregation some components were lagged to adjust their phases to the target phase.

The result of this process was a series expressed as a deviation from long-term trend with a standardised amplitude.

Weighting system

Since the components used in the CLI differ in their performance as leading indicators, one might think that giving more weight to components that have a better historical performance could potentially improve the performance of the CLI. One may also believe that a weighting system could improve the "fit" of the composite to the reference series.

One way of incorporating a system of weights is by estimating a multivariate equation. Unfortunately, the selected indicators as a group of data series do not provide a model of the business cycle, but simply show cyclical conformity with the reference series for various theoretical reasons (de Leuew, 1989). Therefore, it is not possible to use regression techniques to find a weighting system which maximises the fit of the CLI to the reference series and conforms to the constraints of all weights being positive and summing to one.

An alternative way of deriving weights is to construct a scoring system based on the forecasting abilities of individual indicators. In developing the CLI on an experimental basis, the following characteristics were taken into account:

- correlation with the reference series;
- missing or extra cycles;
- number of false signals;
- reliability or regularity at turning points;
- timeliness; and
- length of the series.

The scoring system awarded points to each series when individual criteria were fulfilled. The objective was to get a set of positive weights summing to one.

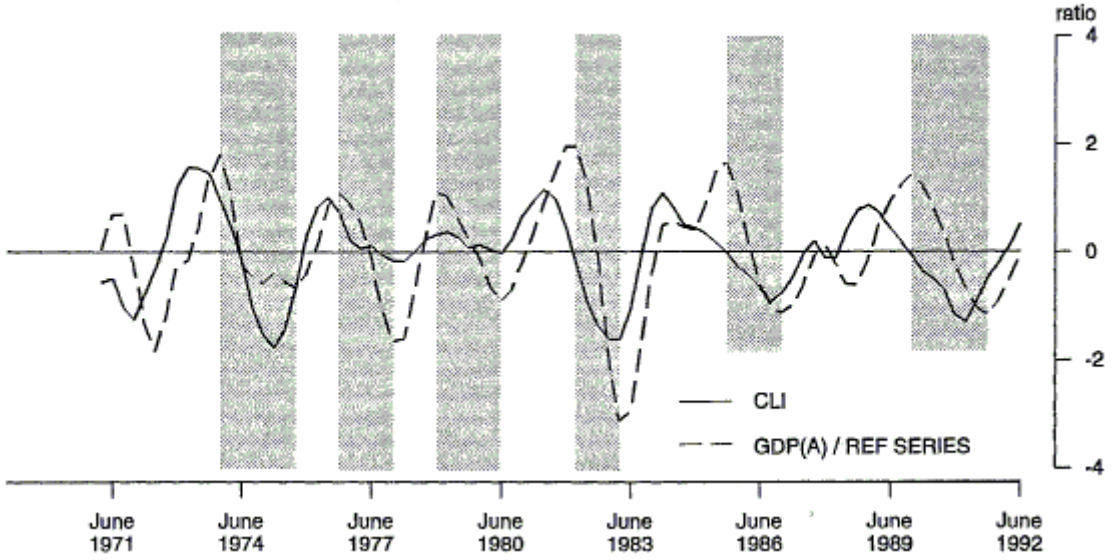
The experiment showed that the weights obtained from scores had very little influence on the performance of the CLI. An explanation is that, since the components have been selected using the same criteria, their overall performances are roughly equal on average. An indicator with poor overall performance would not have been chosen and one with outstanding performance would be used on its own. Therefore, the weights obtained by a scoring system were not sufficiently different from each other to change the performance of the resultant CLI.

Moreover, giving different weights to the components of the CLI also implies allocating different degrees of importance to the selected causes, early manifestations and expectations related to the business cycle. It is very unlikely that economic theory would support this because all cycles are different in their causes and effects. In addition, it is probable that the weighting system applying to the current cycle would not be suitable for every subsequent cycle. Most of the institutions which have developed CLIs do not use weights for the reasons described above. The above factors have led to the decision to use equal weights for aggregating the standardised components.

Cyclical conformity and lead length of the CLI

In this study, an indicator is said to demonstrate cyclical conformity with the reference series when it shows one, and only one, cycle per cycle of the reference series. As can be seen from chart 1, the CLI did not show any missing or extra cycles. The last cycle of the 1970s, which went from a trough in the December quarter 1977 to a peak in the December quarter 1978, falling again to a trough in the June quarter 1980, was very weak in the CLI, but nevertheless present. This cycle was largely due to the agricultural sector and consequently was difficult to track and anticipate. Not surprisingly, the turning points associated with this cycle were the only ones on which the CLI did not lead.

CHART 1. COMPOSITE LEADING INDICATOR AND GDP(A) DEVIATION FROM LONG-TERM TREND



No false signals (defined as more than one quarter of change in direction where there is no turning point nearby) were present. The double turn in 1987 in the CLI, associated with the stock market crash, led the 1987 double-turn in GDP(A).

Charts 2A and 2B show the number of occurrences of lead values in the CLI at peaks and

troughs respectively. They show clearly that the lead time was much more regular at troughs than at peaks. With the exception of the two values corresponding to the last cycle of the 1970s which were minus one and zero, all leads at troughs were either of two or one quarters. The lead at peaks was spread between one and six quarters. The six quarter lead, rather longer than the average, was observed in the March quarter 1984. On average the CLI led the business cycle by two quarters. Cross-correlation calculations produced the highest correlation between the CLI and GDP(A) when the CLI lead the business cycle by two quarters.

CHART 2A. OCCURRENCES OF DIFFERENT CLI LEADS IN TROUGHS

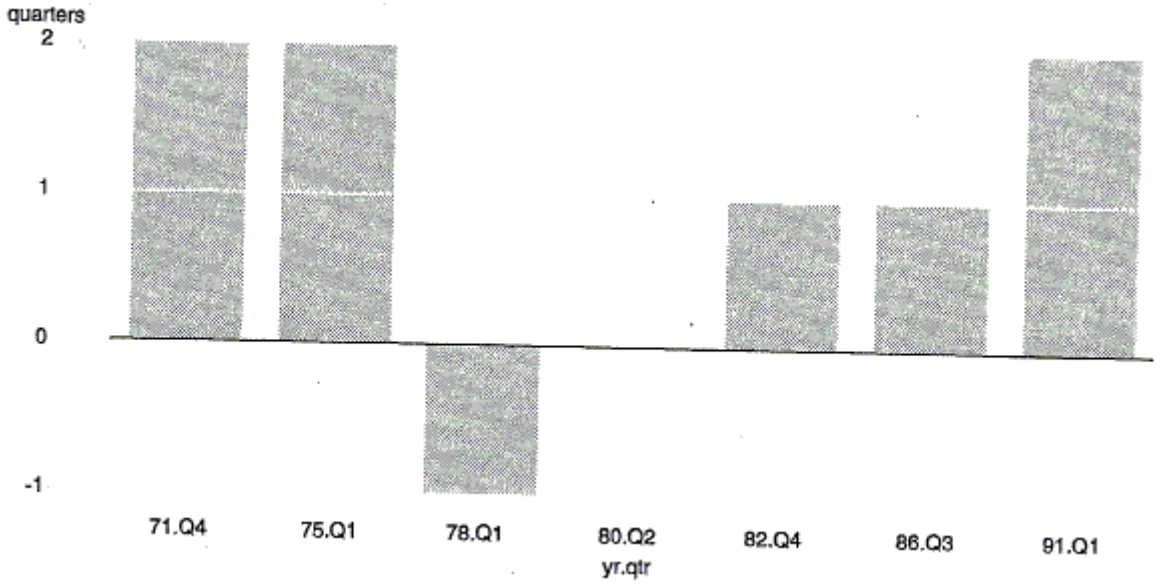
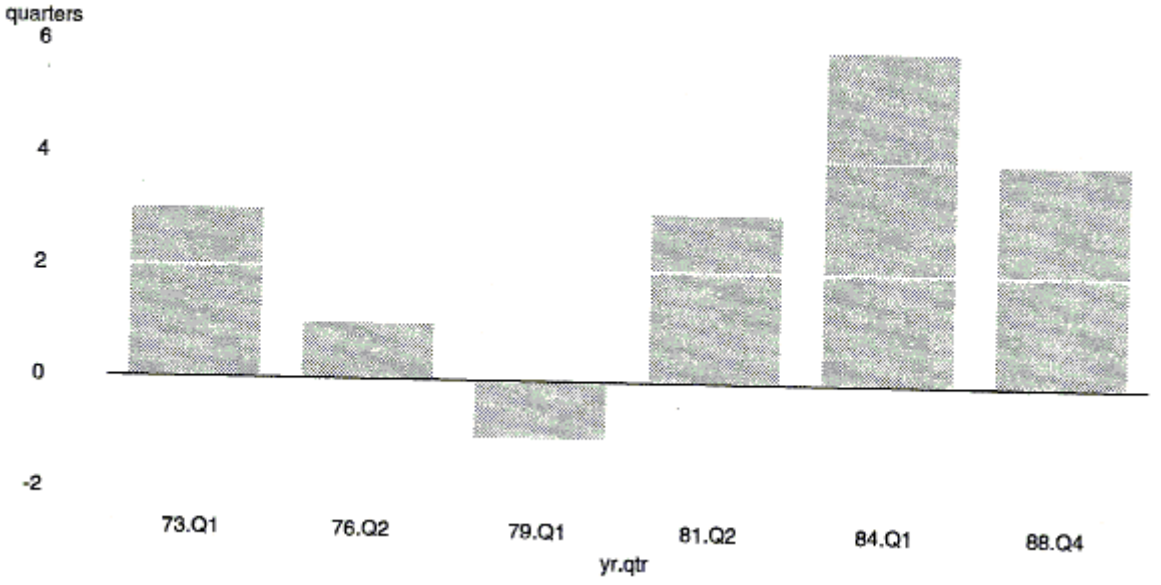


CHART 2B. OCCURRENCES OF DIFFERENT CLI LEADS IN PEAKS



Timeliness

The timeliness of the CLI depends on the timeliness of the last component available and therefore it will be available between one and two months after the end of the reference period. The timeliness of data was a criterion for the selection of components in order to ensure that all components would be available at the time of calculation of the CLI for a particular period, thus avoiding the need to calculate an incomplete composite. The final domestic demand price index

used for calculating the real interest rate comes from quarterly national accounts data but, as it is lagged by four quarters in the aggregation, it does not interfere with the overall timeliness of the indicator.

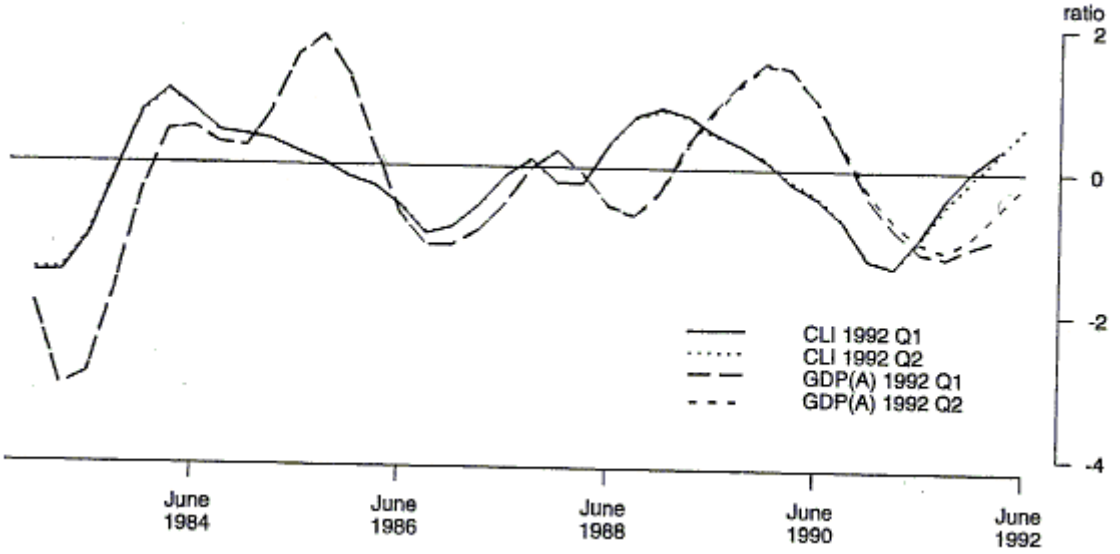
Leading the reference series by two quarters on average, the CLI gives some indication of potential movements in the business cycle between four and five months before the end of the corresponding quarter. The dynamic simulation reported below showed that, because data for additional periods are always needed to determine and confirm turning points, the information given by the CLI actually coincides with business cycle developments.

Using the CLI in dynamic mode: data revisions

The CLI historical time series is only used for evaluating the performance of the CLI in past cycles in static mode. However, the main use of the CLI being the early detection of turning points in economic activity, it is only the current end of the series that will be of interest, quarter after quarter. There are two complications at the end of the series. First, GDP(A) data, as well as some of the data used in the CLI, are subject to revision from quarter to quarter. Second, systematic revisions to trend estimates are induced by the use of Henderson moving averages as shown below.

Chart 3 shows two generations of the CLI obtained with two recent generations of component data. The corresponding generations of GDP(A) (expressed as deviations from trend) are also present in chart 3. This shows that revisions in the CLI were minor, the two corresponding lines being virtually on top of each other. The reason is that only three components, namely US GDP, housing finance and real interest rates, are subject to revision of the data itself. These revisions, largely due to irregular components, tend to cancel each other out. Revisions in the component series incorporate both the effects of actual revisions in the data and revisions due to filtering. It is possible to isolate the effects of filtering, and this is described in the following paragraph. The most recent generation of data available has not been used for the purpose of analysing data revisions because it includes the change in the base year of constant price estimates from 1984-85 to 1989-90, and therefore reflects more than routine revisions.

CHART 3. EFFECTS OF REVISIONS ON GDP(A) AND CLI



Effects of filtering

A Henderson moving average (HMA) is a weighted moving average centred on the observation being adjusted. Long-term trends have been estimated using a thirty three-term HMA while the series have been smoothed using a seven-term HMA. As with all centred moving averages, surrogate weights are needed for estimating the trend at the end points of the time series. When more data points become available, the distance of the observation being adjusted from the end of the series lengthens and the surrogates gradually converge towards the real HMA. The successive surrogates induce systematic revisions at the end of the smoothed series and therefore at the end of the deviation from trend series. The effects of the HMAs on the end-points have been simulated by taking the final data available at the time of the study and cutting the series successively at each quarter since 1981. The shortened time series were then smoothed and de-trended. This made it possible to examine the effect of the filters alone without the impact of other revisions to the data. All the data used were from the latest generation available at the time of the study, the June quarter 1992. All turning points from 1981 were simulated and three are used to illustrate the method and the results obtained.

Chart 4 shows the results of the simulation of the developments in the CLI just before and through the March quarter 1983 trough. The successive generations of CLIs are labelled using their reference quarters: the December quarter 1982, the March quarter 1983, the June quarter 1983 and the September quarter 1983. The overall message is that the CLI has turned consistently around the turning point. With the March quarter 1983 generation, the fall in the CLI was stopped. With the June quarter 1983 generation, the turning point appeared with two consecutive quarters of positive growth. A preliminary date for the trough was found in the CLI in the December quarter 1982, heralding a trough in GDP(A) in the March or June 1983 quarters. This date was subsequently confirmed. Chart 4 contains the most recent generation of GDP(A) for comparison. In this case, although the CLI did not lead the developments themselves, it would have led the release of information on the occurrence of a turning point.

CHART 4. SIMULATION OF 1983 Q1 TROUGH

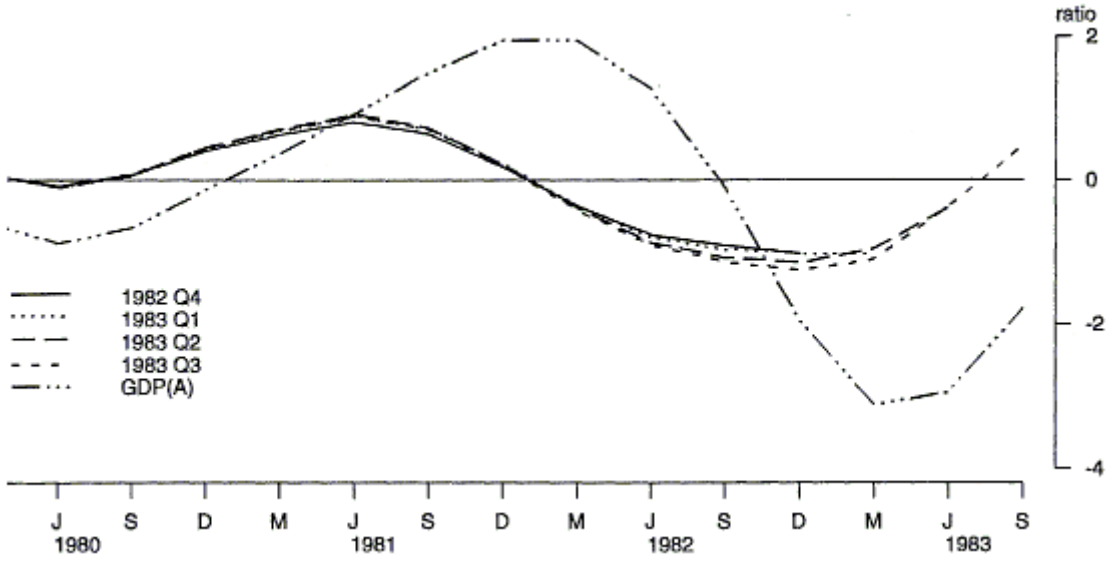
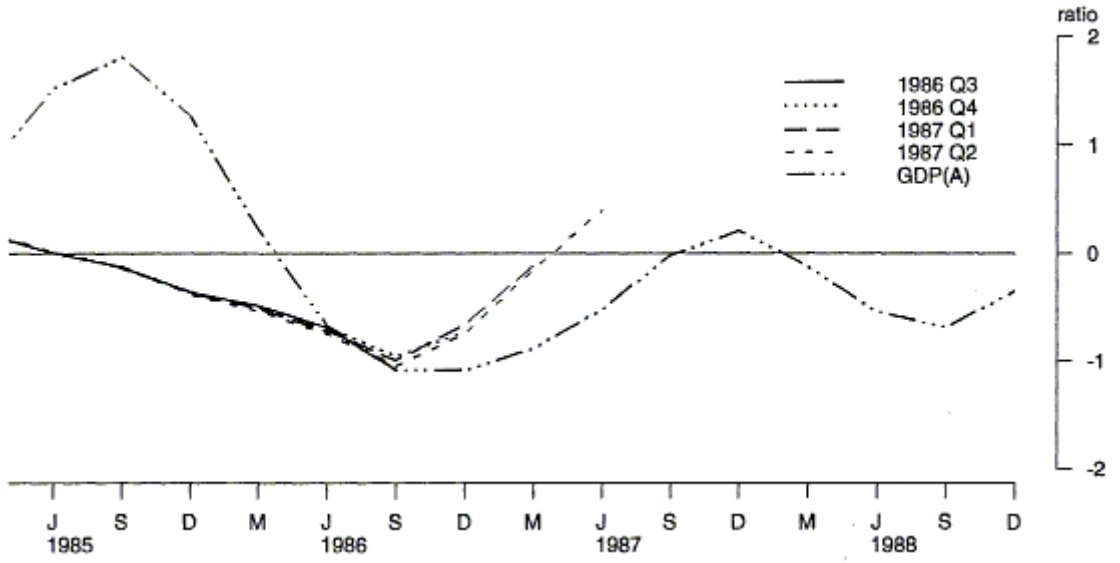


Chart 5 shows the results of the simulation just before and through the December quarter 1986 trough. The overall message is that there is no false signal around the turning point period. As on the previous chart, the successive generations of CLIs are labelled using their reference quarters: the September quarter 1986, the December quarter 1986, the March quarter 1987 and the June quarter 1987. With the December quarter 1986 generation the turning point appeared with only one quarter of positive growth. A preliminary date for the trough was found in the CLI in the September quarter 1986, heralding a trough in GDP(A) in the December 1986 or March 1987

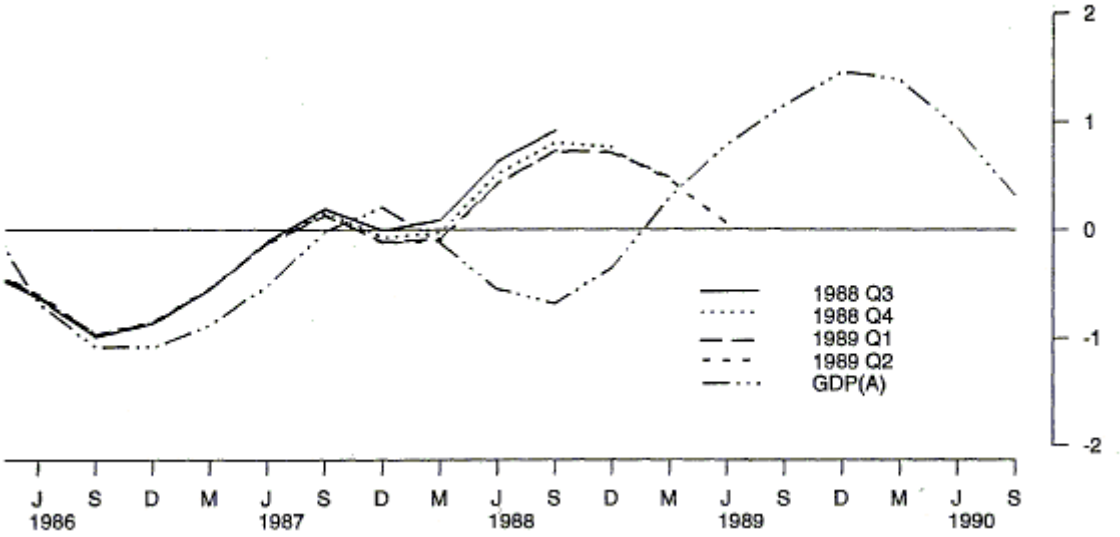
quarters, the former having been confirmed since then. In this case the CLI would have also led the release of information on the occurrence of a turning point.

CHART 5. SIMULATION OF 1986 TROUGH



Another interesting point coming out of the simulation exercise is the way the CLI deals with the double turn in the December quarter 1986-December quarter 1989 expansion. Chart 6 shows how a turning point progressively appears in successive generations of the CLI. A one quarter fall acknowledged the 1987 double turn with following data implying continued growth. Then, with the September quarter 1988 generation, two consecutive quarters of fall signalled a turning point ahead. This was confirmed by subsequent generations of data.

CHART 6. SIMULATION OF THE CL1 AROUND THE 1989 Q4 PEAK



The two main conclusions to be drawn from the simulations are the following:

- The trending and smoothing techniques do not induce instability in measuring the timing of turning points. In all cases where a local maximum/minimum was detected, it was

confirmed with the next quarter of data. All except one of the turning points in the CLI stabilised in the same quarter in which the turning points were first observed. The exception, the peak in the December quarter 1988, was first observed to be in the September quarter 1988. By the addition of data corresponding to the generation ending in the June quarter 1989 the peak moved to the December quarter 1988 and subsequently stabilised.

- There were no false signals from the CLI and all turning points were picked up.

The use of the CLI in forecasting mode

The main use of a CLI constructed as described is to help in the early detection of turning points in the business cycle. The evaluation of performance, and particularly the dynamic simulations, have shown how a turning point gradually appears in the CLI. The CLI is being tested with data as they become available to confirm this performance.

It is important to note that the amplitude of the CLI at turning points cannot be used as an indicator of the amplitude of the corresponding cycle. The CLI does not give any indication of the level of the reference series at any particular point in time.

The second output of this analysis is the level of the underlying long-term trend of the reference series. The long-term cycles and the business cycles interact and should be used in conjunction. The long-term trend provides information on the average performance of the economy over the last four to eight years. It is derived by using a thirty three-term HMA. These averages are centred on the point under consideration (ie. sixteen observations before and sixteen observations after the point of interest are included in the weighted average). At the end of the series the sixteen observations after the point of interest are not available. Surrogates, which are shorter and non-centred moving averages, are used as a solution to the problem. As more data become available, longer averages can be used until finally, sixteen quarters later, the final long-term trend estimate becomes available. In the meantime, the long-term trend is continually revised depending on the subsequent values of GDP(A). These revisions affect the level of the CLI but, as shown by the simulations, do not influence its movements and therefore the detection of turning points.

For reasons of presentation, the average amplitude and the long-term trend of the reference series could be re-incorporated into the CLI to create a series that looks comparable to GDP(A) in level terms. It has been decided not to do so since this series could be misleading. As indicated above, the level of the CLI is not related to the level of the business cycle and this series cannot be used as a predictor of the level or the growth rate of GDP(A).

One final element to take into account when using the CLI is the contribution of each individual component to the movement of the composite. In doing so, some information may be added to help in interpreting the final results.

Conclusion

This study has produced a composite leading indicator which, with one exception, has led consistently the major turning points in the Australian business cycle as defined by deviations of GDP(A) from its long-term trend. The one exception was the December quarter 1977-December quarter 1978-June quarter 1980 cycle, during which the CLI was coincident with the business cycle. The components have been selected for their balanced coverage of the various types of economic indicators available. The CLI has been proven to be robust in dating turning points in dynamic mode, picking up all turning points in the 1980s and not showing any false signals. Real time testing is being conducted as data become available to confirm this performance.

To ensure that the CLI continues to perform correctly on future cycles, it is essential that relevant coverage of the economy be maintained. As a result, the components will be reviewed periodically, from one cycle to another, in order to take into account long-term changes in the structure of the economy.

References

Australian Bureau of Statistics, A Guide to Smoothing Time Series - Estimates of Trends (cat. no. 1316.0), 1987.

Boehm, Ernst and Geoffrey H. Moore, New Economic Indicators for Australia, 1949-84, Australian Economic Review, 4, 1984.

de Leuew, Frank. 1989. Leading Indicators and the "Prime Mover" view. Survey of Current Business, August 1989.

Salou, Gerard and Cynthia Kim. 1992. The Australian Business Cycle 1959-1992. Australian Economic Indicators. Australian Bureau of Statistics (cat. no. 1350.0), August 1992.

Salou, Gerard and Cynthia Kim. "Leading Indicators of the Australian Business Cycle: Performance over the Last Two Decades. Australian Economic Indicators". Australian Bureau of Statistics (cat. no. 1350.0), October 1992.

Zarnowitz, Victor, Business Cycles, Theory, History, Indicators and Forecasting, The University of Chicago Press, Chicago, 1992.

This page last updated 14 December 2009